



RI Water Resources Board

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Hydrologic Drought Indices

Generally, when three of the four major hydrologic indices reach a designated threshold, a corresponding drought phase is assigned. Please refer to the table, Hydrologic Drought Indices and Phases below. The four major indices are: the Palmer Drought Index, precipitation, ground water and stream flow. Precipitation, groundwater and surface water are evaluated in terms of departure from normal. Normal is defined as the statistical average of the data for the period of record.

Palmer Drought Index (PDI): PDI is an index that reflects soil moisture and weather conditions, including temperature. It is compiled by the National Weather Service and the National Climatic Data Center.

Crop Moisture Index (CMI): CMI is an index that reflects short-term soil moisture conditions, particularly as it pertains to agriculture. The agricultural sector is usually the first to be affected because of its heavy dependence on stored soil water, which can be rapidly depleted in extended dry periods.

Precipitation: Precipitation data is collected by the National Weather Service at eight data points and reported by county. A drought phase determination is based on conditions relative to normal in three, six, and twelve-month intervals.

Ground Water Levels: Ground water levels are monitored by the US Geological Survey from 38 observation wells. A drought phase determination is based on the number of months ground water levels are below normal (lowest 25% of period of record). Local water suppliers also monitor public wells in order to make seasonal water availability comparisons.

Stream Flow: Stream flow conditions are monitored by the US Geological Survey from 21 near-real-time stations with 30 or more years of record. A drought phase determination is based on the number of months that stream flow levels are below normal compared to historical trend data.

Surface Water Reservoir Levels: Reservoir data is typically reported by water suppliers, relative to normal conditions or percent "full". A drought phase determination considers historic monthly averages of small, medium, and large index reservoirs.

Drought Indices and Phases						
Drought Level	PDI	CMI	Precipitation	Ground Water	Stream Flow	Surface Water Reservoirs
Normal	-1.0 to -1.99	0.0 to -1.0 Slightly dry	1 month below normal	1 month below normal	2 consec. months below normal	Reservoir levels at or near normal for the time of year
Advisory	-2.0 to 3.99	-1.0 to -1.9 Abnormally dry	2 month cumulative below 65% of normal	At least 2 out of 3 months below normal	3 consec. months below normal	Small index Reservoirs below normal
Watch	-3.0 to 3.99	-2.0 to -2.9 Excessively dry	1 of the following criteria met: 3 month cum. <65% or 6 months cum. <70% or 12 months cum. <70%	4-5 consecutive months below normal	At least 4 out of 5 consec. months below normal	Medium index Reservoir normal
Warning	-4.0 and below	>-2.9 Severely dry	2 out of 3 of the above criteria met: 3 months cum. <65% and 6 months cum. <65% and 12 months cum. <65% or 3 months cum. <65% and 12 months cum. <65%	6-7 consecutive months below normal	At least 6 out of 17 consec. months below normal	Large index reservoir below normal
Emergency	-4.0 and below	>-2.9 Severely dry	Same criteria as Warning and Previous month was Warning Emergency	7 months below normal observation wells recording monthly record lows	>7 months below normal	Cont. of previous month's conditions
NOTES: PDI and CMI are short-term indicators. Local triggers will also be considered in assessing drought, such as water storage capacity and other water supply system management considerations, particularly in the later phases of drought.						

Local Water Supply Indices

The Water Resources Board will work closely with suppliers to identify and assess local indicators including, but not limited to, source of supply, static groundwater levels, reservoir levels and other storage and capacity issues. Their relative importance will vary based on time of year and severity of drought. Local triggers are of primary importance in assigning warning and emergency levels.

Assigning Drought Levels Using the Indices

Assessing drought levels is part art and part science. The Water Resources Board will work closely with the National Weather Service, US Geological Survey, and suppliers in recommending drought levels to the Steering Committee. As a rule, when three of the four major hydrologic indicators reach their designated thresholds, a corresponding drought level is assigned. The 'major' hydrologic indicators are the Palmer Index, precipitation, stream flow and groundwater. However, it is important to note that time of year may influence the process considerably. In the fall and winter months, the CMI and PDI may react slowly but decline rapidly once the spring "green-up" occurs. The lag between surface water levels and groundwater levels could similarly

skew the relative importance and number of indicators that are critical to determining the level of drought. In the final two stages, ground water and reservoir data particular to the supplier will be used in conjunction with statewide data to determine drought levels.

Returning to Normal

When precipitation levels return to normal, surface and subsurface supplies return to normal in the same sequence they were affected. Water reserves in soil are replenished first, followed by stream flow, surface water bodies, and groundwater. The length of the recovery period is a function of the intensity of the drought, its duration and the quantity of precipitation received. In order to determine the end of a drought, long-term indices—precipitation and ground water levels—are examined. Precipitation is a key factor because it is the overall impetus for improving drought conditions. The water table responds slowly to improving conditions, thus, it is also a good indicator. A drought phase can only be revised to a less severe condition when normal conditions for both precipitation and ground water have been reached over a sustained period. Precipitation from large storms such as hurricanes will need to be weighed subjectively based on individual impact. While these storms may return long-term precipitation totals to normal and may fill reservoirs, they often do little to replenish groundwater levels for long-term water resource protection. Long-term, cumulative precipitation deficits can change depending on the time of year and length of the drought. For example, the fall and spring months are ideal for groundwater recharge. Precipitation that occurs during the fall and spring can result in a quicker return to normal conditions. The professional judgment of the Drought Steering Committee should be weighed heavily in determining whether to reduce a drought phase. To ensure that long-term improvement continues, the reduction of the drought phase in any given region should be limited to once every two months. For example, the Crop Moisture Index returns to normal at the end of the growing season. In addition, the end of a drought is easily defined by precipitation and ground water levels, which have the most significant impact on the other indices.

Returning to Normal		
Current Drought Phase	Next Drought Phase	Reduce Drought Phase by one category
Emergency	Emergency-continued below normal conditions	Groundwater levels at or above normal and no precipitation deficit for past 3 months; and/or water resource problems which prompted the emergency have abated
Warning	Emergency-worsening conditions or continued below normal conditions	Two consecutive months of groundwater levels at or above normal and near normal precipitation for past 6 months
Watch	Warning-worsening conditions Watch continues below normal	Two consecutive months of groundwater levels at or above normal and near normal precipitation for past 6 months
Advisory	Watch-worsening conditions	Two consecutive months of groundwater levels at or above normal and near normal precipitation for past 3 months